BIOE 580/ BIOC 580/ CHBE 580
PROTEIN ENGINEERING
FALL 2018

LECTURE ROOM: BRC 286 **CLASS MEETING TIME:** TR 10:50AM-12:05PM

INSTRUCTOR
Laura Segatori
Office: BRC 313
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Office Hours: By appointment

TEACHING ASSISTANT
Marjan Majid
Office: BRC 603
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Office Hours: Tuesday 1pm-2pm

COURSE WEBSITE
Canvas (https://canvas.rice.edu)

TEXTBOOK
Class notes and reading assignments

Recommended
Protein Engineering and Design – Edited by Park & Cochran
Proteins: Structure and Function – David Whitford
Introduction to Protein Structure – Branden & Tooze
Molecular Biotechnology – Glick, Pasternak & Patten

COURSE DESCRIPTION AND TOPICS

This course is an introduction to the tools and technologies used to design, engineer, and characterize proteins with altered or novel properties, with particular emphasis on applications in biomedicine and biomaterials, and design of tools for synthetic biology.

Fundamentals of molecular biology and biochemistry will be introduced and discussed from the prospective of protein engineering and genetic engineering applications. Relevant peer-reviewed publications will be presented in class by the instructor and/or by the students and discussed to illustrate applications to current unmet needs in biomedicine and biotechnology.

Topics covered in this course include:
A review on protein structure and characterization techniques
Protein expression and recombinant DNA technologies
Selection
Protein folding and solubility
Display technologies: phage display, cell display, and in vitro display
Screening
Library construction: from random mutagenesis to in vitro recombination
Antibody engineering
Tools for genome engineering
Nucleic acids engineering
De novo and computational design

OBJECTIVES:

- Developing an appreciation for the opportunities and challenges of the protein engineering profession
- Understanding the molecular and cell biology principles involved in the transfer and expression of genetic information
- Identifying genetic engineering tools to manipulate cell systems for desired research and industrial applications
- Understanding the basic differences between rational design and directed evolution of proteins.
- Understanding the differences among the technical procedures available to designing proteins de novo, and for rational design and directed evolution of proteins.
- Identifying the appropriate technology to create a library based on the size and diversity needed. Understanding the difference between random mutagenesis and recombination technologies for library creation.
- Understanding the requisite for high-throughput application of in vitro and cell based assays. Optimization and validation of high-throughput screening assays.
- Working in teams on the application of protein engineering principles and applications to a biomedical or industrial problem of relevance, preparing a technical report and oral presentations.

OUTCOMES:

Students completing this course will learn to:

- Analyze the history and current trends of protein engineering, the grand challenges of this discipline, and the career options available
- Search and analyze journal articles in the topic of protein engineering
- Apply the molecular and cell biology principles involved in the transfer and expression of genetic information to the solution of research problems, particularly those related with the students' own graduate project.
- Use genetic engineering tools for the manipulation of cell systems for desired research and industrial applications.
- Identify the appropriate technologies for the creation of sequence diversity for the solution of a specific research problem or application, with particularly attention to understanding the differences among rational design and directed evolution, and mutagenesis or recombination based techniques.
- Design, optimize and validate assays for high-throughput screening.
- Work in teams on the application of protein engineering principles and applications.

CLASS ATTENDANCE

It is expected that students attend all class meetings and participate to class activities and discussion. This course includes the analysis of the most recent literature in the field. Students are expected to read reviews and journal papers that will be assigned by the instructor and participate in class discussions. Reading material will be posted on the class website; however, class attendance will be necessary for its analysis and understanding.

GRADING POLICY:

Exams (2):	40 %
Quizzes:	20 %
Written report (review):	15 %
Oral Presentation:	15 %
Class participation:	10 %

There will be two exams. The first exam (midterm) will be held in class, with closed book and closed notes. The second exam (final exam) will be a timed, take home exam. Each exam will count 20% of the final grade. Students will also work in teams on a special project. Directions regarding the format of the team project (review or research proposal) will be given in class. Students will be required to present their project orally (~ 20 minutes, 15% of the final grade) and submit a written report (due on the last day of finals, 15 % of the final grade). Quizzes will be scheduled throughout the semester.

PREREQUISITES

There are no prerequisites for this course. It is strongly recommended, however, that students have been exposed to the fundamentals of molecular biology, cell biology, and basic recombinant DNA technologies. If uncertain, students should contact the instructor (segatori@rice.edu) to learn more about the course and decide whether they have the appropriate background.

PLAGIARISM

Plagiarism is the undocumented inclusion of someone else's work within your work, and besides damaging your education, also violates Rice's Honor Code. The consequences for a Rice Honor Council violation typically range between an F in the course to a 2-semester suspension from Rice. We take plagiarism very seriously, be sure that you understand what is an appropriate level of collaboration before sharing information with a colleague. Please do not hesitate to contact the instructor for an explanation of what constitutes an Honor Code violation.

SPECIAL NEEDS

Any student with a documented disability seeking academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All such discussions will remain as confidential as possible. Students with disabilities will need to also contact Disability Support Services in the Ley Student Center.